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ABSTRACT

This paper asserts that the continuing decline in admissions to science and engineering graduate programs may lead to a shortage of skilled professionals that undermines the U.S. economy and to a shortage in higher education faculty. The Louis Stokes Alliance for Minority Participation (LSAMP) provides academic activities and retention services to increase under-represented minority students' success in attaining baccalaureate and graduate degrees in science, engineering, and mathematics. The University of Texas System LSAMP evaluation model was designed with input from the institutional research offices of its partner institutions. A description of the evaluation process and the most successful aspects of the academic program and assessment data are presented. Implications for future higher education partnerships are also outlined. (Contains 23 references.) (Author/SLD)

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A Model Retention Program for Science and Engineering Students:

Contributions of the Institutional Research Office

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The University of Texas System (U.T.-System) LSAMP was established in 1992 with funding from the National Sciences Foundation to increase the participation and graduation of under-represented minority students in science, mathematics, engineering, and technology (SMET). In this paper we will discuss why the program was started, describe its activities and the relationships among the partner institutions, discuss how well it is fulfilling its mission, and outline implications for its partners and other institutions. Three major points will be illustrated: 1) initiation of the program highlighted the need for data and research in the area of under-

represented minority student participation in SMET majors; 2) the community college/university partnership is innovative and necessary for success; and 3) although sometimes overlooked, the Institutional Research office can play a major role in building and maintaining such a partnership.

BACKGROUND

The Workforce and Demographic Challenges – In the past decade, numerous analysts have examined the U.S. economy and determined that profound changes in its educational systems will be required to ensure future prosperity in an increasingly competitive global economy. Marshall and Tucker (1992), for example, conclude that, "The key to both productivity and competitiveness is the skills of our people and our capacity to use highly educated and trained people to maximum advantage in the workplace." (p. xvi) They emphasize that U.S. and other employers increasingly recognize that the skills needed to power a modern economy include abstract, conceptual thinking and the ability to apply that capacity to complex, real-world problems, most of which involve the use of scientific and technical knowledge. Other requirements include effective communication skills and the ability to work in teams (p. 80). Marshall and Tucker argue that evidence shows that poor and under-represented minority students can achieve at world-class levels and, therefore, the educational system must be reformed to attain that success. This message was not only heard by major Texas employers, but they also took an increasingly public leadership role in demanding greater accountability and more coordinated planning by the state's major educational and training systems (Andrade & Campbell, 1995).

In a thorough demographic analysis of Texas, Murdock et al. (1997) outline projected population change scenarios and the impact that these could have on the economic competitiveness and social stability of the state. They demonstrate convincingly that the future of Texas will depend on the extent to which its minority populations will have access to increased economic resources. They concluded, therefore, that significant improvements in the educational attainment of Hispanics and Blacks will be of critical importance for the economic prosperity of Texas.

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The SMET Pipeline – In 1982, the National Science Foundation (NSF) began to explore the academic achievement of women and minority students in science and engineering in terms of degree completion, employment, concentration in specific disciplines, part-time employment, salaries, and tenured/full professorship status (National Science Foundation, 1982). By 1990, NSF had identified an urgent need for the United States to focus on increasing the participation and academic success of women, minority, and handicapped students in science, mathematics, engineering, and technology (National Science Foundation, 1989). The focus was on meeting the needs of employers for a professional and technical workforce and providing opportunities to many capable individuals who had previously been excluded. The U.S. Congress reacted by mandating NSF to develop a series of coordinated responses for improvement of access and academic achievement across the country. Established by NSF in 1991 as a major initiative within this context, the Louis Stokes Alliance for Minority Participation (LSAMP) aims to increase students' opportunities to attain undergraduate and graduate degrees in science, math, engineering and technology (SMET) through student award support, mentoring, research participation, and presentation, as well as faculty innovations in curricular revision and teaching. Its achievements and catalytic role have been recognized nationally (e.g., President's Advisory Commission on Educational Excellence for Hispanic Americans, 2000).

Nonetheless, the most recent NSF publication on the status of women, minorities, and persons with disabilities notes that in spite of progress since 1982, the numbers and percentages of under-represented minorities in engineering continue to decline, challenges to affirmative action are impacting their enrollment in SMET majors, and the attrition rates of minorities in undergraduate education are still higher and baccalaureate degree completion rates lower than other groups (National Science Foundation, 2000). In addition, a prominent national study group emphasized recently that the demand for certified and fully qualified mathematics and science school teachers continues to far outpace the supply (National Commission on Mathematics and Science Teaching for the 21st Century, 2000). This problem is particularly acute in urban school districts, where the majority of under-represented minority students are enrolled.

Within this context, The University of Texas System began to examine the contribution that its academic components could make. During 1991-92, the System's nine universities awarded a

total of 564 baccalaureate degrees in science, engineering, and mathematics to "under-represented minority" students (i.e., Hispanics, Blacks, and others), which represented 20% of the total graduates that year. This pool could not possibly meet the projected demands in Texas for entry-level professional and technical workers, graduate students in SMET disciplines who could undertake future research and become future college faculty, or the public school science and mathematics teachers so badly needed throughout the state. Given the demographic profile outlined above, U.T.-System and campus academic leaders realized that only a dramatic intervention could change this pattern.

In fall 1992, approximately 23,500 undergraduate students were majoring in science, engineering, or mathematics at U.T.-System universities. Not quite 30% (6,957) were under-represented minority students: 25% Hispanic, 4% Black, and less than 1% other (primarily Native American). Thus, there was considerable potential for improvement, if the retention and academic success of these students could be increased. With the formation of the Alliance for Minority Participation, the then six community college partners had a total enrollment of more than 6,000 students majoring in science, pre-engineering or mathematics, 44% of whom were under-represented minority students: 34% Hispanic, 7% Black, and 3% other. This clearly represented another important source of potential SMET students if they could be encouraged to continue on to baccalaureate degree programs and achieve academic success in the partner universities. See Figure 1 for a list of The U.T.-System LSAMP institutional partners.

HOW THE LSAMP FUNCTIONS

The U.T.-System LSAMP consists of two arms. Each partner institution has an official representative from the academic side who coordinates campus LSAMP activities with faculty and students and another with evaluation responsibility, usually from the institutional research office (IR). The first person represents the institution on the LSAMP Academic Leadership Council. The second individual represents the institution on the LSAMP Evaluation Task Force. Meetings of the Evaluation Task Force were initially conducted three times a year. The evaluation group analyzed differences in definitions of key data points between the Texas Higher Education Coordinating Board, to which all their institutions routinely submitted reports, and the

Figure 1

Member Institutions of The University of Texas System LSAMP

University Campuses	Community College Partners
U.T.-Arlington	Collin County Community College District Dallas County Community College District (Tarrant County Junior College District)
U.T.-Austin	Austin Community College District
U.T.-Brownsville	Texas Southmost College
U.T.-Dallas	Collin County Community College District Dallas County Community College District
U.T.-El Paso	El Paso Community College District
U.T.-Pan American	(South Texas Community College District)
U.T.-Permian Basin	(Howard County Community College District) (Midland College) (Odessa College)
U.T.-San Antonio	Alamo Community College District
U.T. Tyler	(Tyler Junior College)

Note: (Community colleges in parentheses) joined the LSAMP in subsequent years.

National Science Foundation to ensure accuracy and reliability. It also assisted in finalizing the design of the evaluation model and subsequently in gathering and submitting campus data for NSF reports. In several instances, the representative from a university or community college served as both the academic and evaluation representative. This situation provided for an in-depth perspective of the program, yet created a very large workload for one individual.

Throughout the life of the LSAMP program there has also been considerable transition in the representatives to both the academic and evaluation groups. The program is complex, encompassing not only science and engineering departments, but also the financial aid offices, admissions, and external grants. Changes in leadership presented additional challenges to maintaining continuity in the evolution of the program goals. In the best of circumstances, a

university's bureaucracy is difficult to chart and maneuver through. Changes in the campus program participants could create communication problems until the new representative learned about the program. The Evaluation Task Force continues to meet twice a year, once at the regional meeting of the Texas Association for Institutional Research and once during the summer U.T.-System LSAMP conference.

University Perspective -- The actual process of sharing data with partner institutions creates some interesting challenges. U.T.-Arlington has been involved in evaluating post-transfer performance with three large community college districts in the Dallas-Ft. Worth area, and the results are still not conclusive. Because of the data elements available, UT-Arlington has a difficult time determining the courses transferred in from a particular campus. Recent changes in the database should eventually resolve this problem, but in the interim, it creates a hurdle to overcome. One methodology to address this problem requires community colleges to first identify students who transferred out of their institution, with U.T.-Arlington then providing data on the students and how they are performing at the university level. UT-Arlington also provided aggregate data to these institutions on the success of its first-time freshman students for comparative purposes.

After a student has transferred to a university, the responsibility for retention shifts from the community college to the university. The LSAMP emphasizes the retention of such students, but encourages each institution to develop its own approach, not specifying how to do this. A recent Texas legislative requirement calls for each public university to develop a Recruitment and Retention Plan that requires an extensive internal and external analysis to determine "why students choose to attend or not attend their institution, and why their students succeed or fail."[1] The legislature's goal is for the population of Texas university students to mirror the population of the state. To accomplish this, Texas universities will have to attract and retain larger numbers of currently under-represented students, including Hispanic, Black, and Native American students. Since 1993, the U.T.-System LSAMP has targeted these same populations for science, engineering and mathematics disciplines, with an additional goal of increasing the numbers of

[1] Texas Higher Education Coordinating Board. (2000), Appendix 1, p i.

these students groups who complete baccalaureate degrees and continue on to SMET graduate programs.

Community College Perspective -- The U.T.-System LSAMP campus organization at the community colleges was similar to that of the universities, having one academic member and one evaluation member. In the case of Collin County Community College District (CCCCD), the vice president for academic affairs serves on the Academic Council, and a student services representative was chosen as the evaluation team member who then communicates with the institutional research office. While this was not the typical model for other institutions, communication has been effective on this campus.

The immediate benefit of LSAMP was the statewide collaborations for academic leaders and for faculty representatives in mathematics, physics, chemistry, engineering, and computer science. For example, an initial goal of the Academic Task Force was the review and improvement of gateway science and mathematics courses. Because the number of baccalaureate graduates in Texas had decreased in SMET majors and was so low among under-represented minority students, the U.T.-System LSAMP aimed to open a statewide dialogue about shifting the emphasis of gateway courses from theory-based instruction to application-based approaches. The national trends of Harvard Calculus and Chemistry in Context were noted as cutting edge methodologies in changing teaching. The use of graphing calculators in teaching calculus and real-time data collection computer software in the sciences and mathematics reformed the teaching and application in SMET departments more radically than any methodology change in the last 50 years.

Through the LSAMP, for the first time (to our knowledge), community college and University of Texas faculty were collaborating across the system on course design regarding content and teaching methodologies. This has been a groundbreaking opportunity for both partner institutions. For example, Collin County Community College District now offers more advanced SMET courses. We based our original curriculum on the most advanced academic models available. Our participation in the Texas LSAMP led to the creation of the Center for the

Advanced Study of Mathematics and Natural Sciences, which provides advanced level courses for SMET majors planning to attend graduate school or medical school.

Community college and university collaboration on curriculum enhanced both institutions' academic departments. A direct result for Collin County CCD was a clear alliance with U.T.-Dallas that resulted in the signing of a Concurrent Admissions Agreement. U.T.-Dallas has worked with the community college district closely to recruit our SMET graduates and provided scholarships in addition to the LSAMP funding. Collin County's transfer SMET students were awarded U.T.-Dallas' most prestigious scholarship for five consecutive years, a clear recognition of LSAMP accomplishments.

Two slightly different summer bridge models, one from U.T.-Dallas and the other from U.T.-Arlington have both proven effective for Collin County CCD students. The summer- long research program at U.T.-Arlington offers full research opportunities to the students. In contrast, a "Maymester" (two-week) orientation course with additional mentoring activities is offered at U.T.-Dallas. U.T.-Dallas was innovative in accommodating our students in this shorter orientation course, with day and evening sections. This flexible approach creates viable options for our students. The Dallas-Ft. Worth Metroplex student often works fulltime while attending school and raising a family. Full-time involvement in research often appears to be a dream or practical impossibility for such students who are interested in SMET careers.

Impact of the IR Office -- Prior to the development of the U.T.-System LSAMP, meetings and data sharing between institutional research staff from universities and their feeder community colleges seldom occurred. The Evaluation Task Force provided an opportunity for research and other staff to communicate and gain perspective on the conditions at fellow campuses. Topics of discussion often focused on the campus policy environment, IR office working conditions, and characteristics of students on different campuses, as well as some of the challenges that students encounter when moving through and between the institutions.

The program design also provided an opportunity for IR support staff to work closely with an on-campus academic program from its inception. This approach provided valuable insight into

academic operations and aided in the development of new or expanded working relationships between faculty and IR representatives. The university faculty members who were primarily responsible for campus LSAMP reports received direct assistance in preparing them so that they could focus on program operation and have less federal paperwork to prepare.

As relationships developed over the several years, university and community college institutional research offices shared notes about thorny reporting and evaluation issues. For example, when a community college requests data from a receiving university on their students who transferred there, joint decisions need to be made about how many and which courses completed define a community college transfer student, as well as which university data elements best determine those transfer students' educational success. The most frequently requested elements are grade-point-average and whether the student has earned a baccalaureate degree. Other data (e.g., admission mode, transfer hours accepted, student classification, major, credit hours attempted and earned, time-to-degree) are also useful. Once data are supplied, variable and code definitions must also be transmitted, and lines of communication must remain open to better ensure that analysis is accurate. Both institutions need to explore the analysis process and to interpret the findings for the mutual benefit of their faculty and academic administrators.

For several U.T.-System LSAMP universities, the process of data sharing is still unidirectional, with the university supplying data but obtaining little feedback from its community college partners. This partially reflects that more limited institutional research resources available to the community colleges. University and community college researchers could benefit by jointly analyzing data from each other's campuses, therefore gaining a better understanding of the data. The Alliance Evaluation Task Force opened up this process and continues to encourage cooperative activities and pilot projects.

HOW TO JUDGE WHETHER THE LSAMP PARTNERSHIP IS EFFECTIVE

Alliance Outcomes -- The original 1992 goal of the U.T.-System LSAMP was to generate a total of 1,084 Hispanic, Black and Native American baccalaureate graduates in science,

engineering and mathematics institutions by fall 1997, that is, to double the number of under-represented minority students who could continue on to professional and technical careers.

The U.T.-System LSAMP did not double the number of its under-represented minority SMET students in five years. Just as the Alliance leadership had predicted, it took almost two years to build the partnership and initiate the ambitious exchange of ideas, models, and pilot projects anticipated. Nonetheless, the very positive increase in baccalaureate degrees over this initial project period was reassuring (see Figure 2). This was particularly impressive when the LSAMP demonstrated that under-represented minority students were graduating at a rate of 41.3% in contrast to 19.3% for all SMET baccalaureate recipients, while the U.T.-System total rate had actually decreased by 2.6%. The Alliance received a second round of funding from NSF and set a new baccalaureate goal of 1,374 B.S. degrees by fall 2002, and this trend of a larger percentage of growth in contrast to the U.T.-System as a whole continued (see Figure 3).

Figure 2

The University of Texas LSAMP

SMET Bachelor's Degrees Awarded to Under-represented Minority Students:

Baseline Year (1991-92) through Year 5 (1996-97)

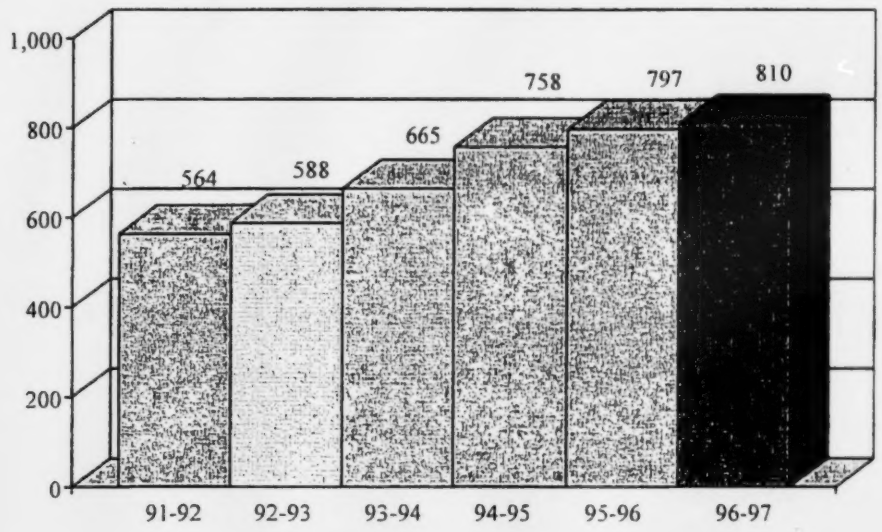
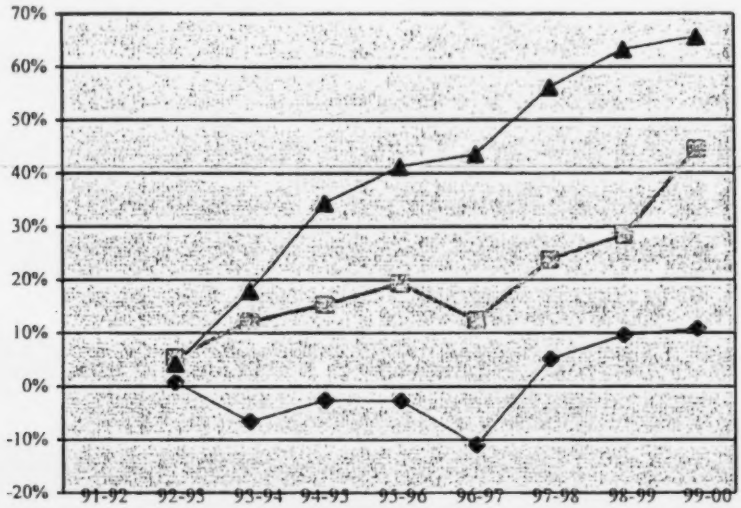


Figure 3

U.T.-System Bachelor's Degrees –

Total, All SMET, and Under-represented Minority SMET Students:

Annual Percentage Change from the Baseline Year



Total UT-System	Baseline	0.8%	-6.6%	-2.6%	-2.7%	-11.0%	5.1%	9.6%	10.8%
All UT-System SMET	Baseline	5.4%	12.1%	15.3%	19.3%	12.4%	23.8%	28.4%	44.5%
UT-System URM SMET	Baseline	4.3%	17.9%	34.4%	41.3%	43.6%	56.2%	63.3%	65.6%

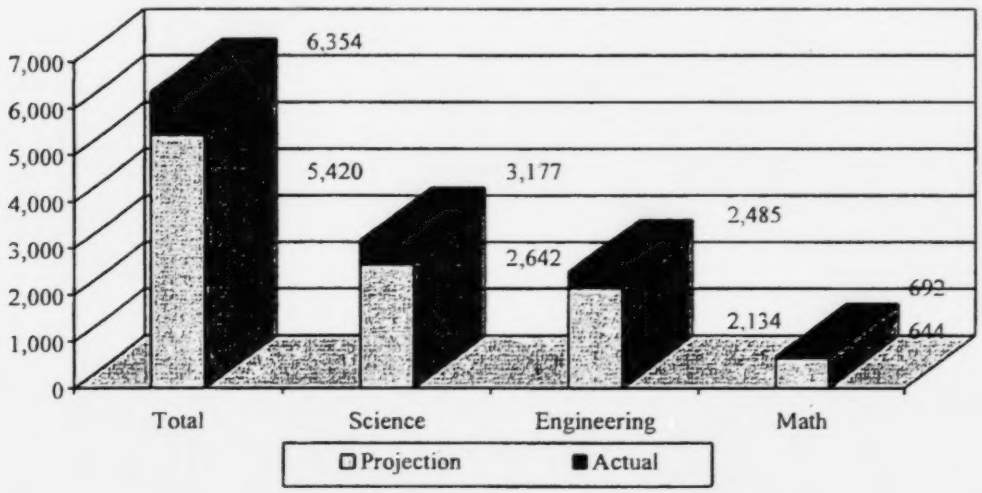
By its sixth year, the U.T.-System LSAMP had added five new community college partners and was demonstrating an important effect on SMET educational outcomes. The upward trend in production of baccalaureate degree recipients was continuing, but more importantly, the Alliance sought to demonstrate that it had added significant value to Texas' pool of professionals and technological experts beyond whatever dynamics accounted for the increased number and percentages of all SMET graduates. Therefore, the U.T.-System Alliance partners argued that by any national comparisons, no one would expect under-represented minority students to graduate at the same rate as other students; indeed, most such figures are extraordinarily lower. The LSAMP calculated the average rate of increase in SMET baccalaureate degrees across the entire U.T.-System and then applied that rate to the baseline number of under-represented minority students to project a figure that might be expected if those students were to persist and graduate at the same

rate as others regardless of race/ethnicity: 5,420 degrees. In contrast, the LSAMP demonstrated that under-represented minority SMET students were graduating at a dramatically higher rate and that given the 8th year total of 6,354 baccalaureate recipients, the Alliance could account for almost 1,000 additional such baccalaureate recipients during that period (see Figure 4).

Figure 4

SMET Bachelor's Degrees Awarded to Under-represented Minority Students by Academic Fields

Contrasted to Expected Increases - Based on Average UT-System SMET Performance: Seven-Year Totals (1992-93 to 1999-00)



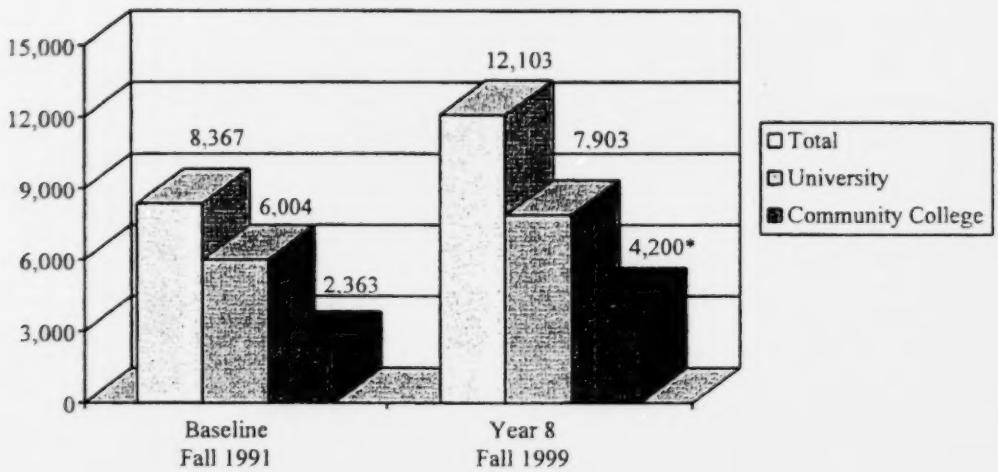
In addition, the participation of under-represented minority students had expanded as demonstrated in the steady growth in their enrollment (see Figure 5), a 31.6% increase in contrast to the 20.5% increase for all SMET students.

Furthermore, the academic performance of the 391 LSAMP Community College Summer Bridge participants and the 455 LSAMP University Research participants was outstanding across all the partner campuses. Members of the seven cohorts of community college transfer students had graduated at a rate of 33 percent by the seventh year of the Alliance, and another 23 percent were still enrolled at a Texas public university or college. About half (45%) could not be located. These are extraordinary results given the typical pattern of low transfer and low graduation for

under-represented minority students who begin their postsecondary studies at a community college. Even more impressive has been the academic success of the students in the seven cohorts of university awardees. More than half (54%) have completed their baccalaureate degree, and another 38 percent are still enrolled in SMET programs. Only nine percent could not be tracked.

Figure 5

Undergraduate Enrollment of Under-represented Minority SMET Students in All U.T.-System Alliance Institutions – Total, University, and Community College: Baseline Year and Year 8



* Year 8 does not include data from five community college partners: Howard, Midland, Odessa, South Texas and Tarrant County College. The number presented represents a projection based on enrollment trends of those institutions, plus the actual figures from the other community college partners.

Alliance Perspective - Participation of the U.T.-System Alliance in the national LSAMP network also led to increased collegial interaction and sharing of innovations with Alliances in other regions. Close to the home front, the U.T.-System LSAMP interacted in a systematic fashion with the Texas A&M LSAMP, possibly for the first time, to explore reporting and transfer issues among their institutions. The University of California System and the California State University System Alliances shared insights into the attempts of another large multi-ethnic state to respond to NSF's challenge. The University of Puerto Rico LSAMP provided technical

assistance on longitudinal tracking of SMET undergraduate students and more systemic evaluations of the outcomes of academic programs. From this latter consultation grew a comprehensive approach to evaluating the efficiency and effectiveness of a curricular and instructional reform effort by the U.T.-El Paso mathematics department (Andrade, in press). The ICE^2 (ICE-squared) model tracked cohorts of first-time freshmen students enrolled in Precalculus for several years, using as the outcome measures their performance in Calculus I and the extent of attainment of the department's goal to increase the pool of qualified students who were interested in and motivated to pursue SMET academic careers. The LSAMP provided training and replication materials on this model to all of its partner institutions, and several have explored its application on their campuses, for example, the U.T.-Austin applying it to Calculus (Hanson et al., 1999).

At the invitation of the National Science Foundation and with a small amount of pilot funding, the U.T.-System Alliance worked collaboratively to design a Virtual Institute that demonstrated how the LSAMPs could generate a clearinghouse of information and services on the World Wide Web to improve science, mathematics, engineering, and technology education and to increase undergraduate student achievement. The U.T. Alliance created a Virtual Center for Formative Evaluation that highlighted best practices in SMET formative evaluation models, assessment tools, case studies, and reporting strategies, as well as providing a site for dialogue about these resources (see http://ampvi.utep.edu).

University Perspective – With all the interest in student outcomes and the desire to specifically increase the enrollment of under-represented groups in higher education came the desire to determine the impact of student service programs on student success. This supports the work of Hanson and Swann (1993) who found that performance in the classroom was the most important variable in explaining student retention, college preparation was second, and participation in multiple student service retention programs was third.

Many of these programs do not have adequate data on student participation to perform an evaluation. Data from the few programs that did have sufficient data have been used to develop models for possible evaluation of other programs. One such program at UT-Arlington requires

students to swipe their ID card, which has a magnetic strip, through a card reader prior to using the facility. An electronic file was prepared using the student's ID number, and the ID was matched with the necessary databases to determine the student's academic and personal characteristics. For this model, the level of services provided is not recorded, thus, it is impossible to determine if those students who used the service more frequently had higher retention rates than the students who had a lower level of involvement in the program. Counts of the number of times each participant entered the facility could be obtained, but it could not be determined what they were doing and the extent of their involvement.

Another academic support program at UT-Arlington prepared electronic files containing the ID numbers of participants for the last 10 years and the number of contact hours recorded for each student. This analysis is not complete but should provide level of service comparisons for the program to see if those who utilize the service extensively fare better than those with lower utilization.

For both of these evaluations, the students participating in these service programs were compared to non-participants who were enrolled during the same time frame. In each of these instances, the program participants had higher retention rates than the non-participant group, and the program with 10 years of data had a much higher graduation rate. Using these evaluations as examples has helped other campus services in developing a design for their program evaluation.

Several U.T.-System LSAMP campus activities have focused on teaching and learning. Mathematics, science, and engineering programs are often characterized as being highly selective in their admissions process and introductory courses. Student persistence rates tend to be lower for these programs than those in other areas. For example, one-year attrition rates in U.T.-Austin's College of Engineering are almost twice as high (26.3% versus 14.2%) as for the University as a whole. While some attrition may be attributed to typical student behavior as they explore their career objectives, the classroom experiences students have will certainly drive their decision-making about continuing in SMET majors. To this end, the LSAMP has also provided some guidance for faculty as they develop the teaching strategies that tend to enhance both the learning and retention of students. Models for adapting instructional methods have been

highlighted in the Alliance summer conferences. For example, in an early presentation, Sheila Tobias, a noted critic of science education in the U.S. and a faculty member at the University of Arizona (1990; 1992; 1993) challenged U.T.-System LSAMP faculty to rethink their curricular and instructional practices in introductory science and mathematics courses. Josefina Arce, a faculty member at the University of Puerto Rico shared a longitudinal tracking model and analysis of course efficiency from the Puerto Rican LSAMP (Piñero, 2000). This approach stimulated U.T.-El Paso to develop its ICE-squared model for evaluating gateway courses. U.T.-El Paso also shared its innovative S.O.S.-Mathematics website for students to practice their problem-solving skills. A workshop by Tom Angelo, a national expert on assessment of learning (Angelo & Cross, 1993) showed faculty how to use Classroom Assessment Techniques to improve their interactions with students. Vincent Tinto described the impact that the implementation of campus learning communities can have on freshman student success (Tinto, 1994a; 1994b).

In the future, each academic and student support services program should be evaluated on a continuous improvement cycle of every two or three years. Standard reports need to be developed so that programs can acquire evaluative data on the impact of their programs on students. Programs that show the greatest success should be examined to determine if expansion of the program is feasible and if expansion would yield the desired results.

Community College Perspective – Retention continues to be a major challenge for both the community college and the university. For example, in the Dallas-Fort Worth Metroplex region, students today are less likely to pursue a degree at a single institution. A sign of our times is this dynamic, mobile geographic locale. This is the second largest technology corridor in the United States. Due to the healthy employment options in technology, students are gaining employment after a few courses and then leaving the community college to work at high-wage technology jobs. Students will shop for convenient times and locations and co-enroll in more than one institution of higher education. For example, CCCCD averages 64 percent retention from semester to semester but 41 percent retention from fall to fall.

Student data are being generated on retention rates affected by the use of math lab. One such group uses a swipe ID card and indicates what activity s/he will participate in while in the math lab. The course enrolled in is recorded, as is the length of time in the lab. Data linking student activity and length of time working in the math lab linked to retention rates as well as GPA and other data can be gathered historically, as well. We have tracked students participating in either the math lab or science lab mentoring programs. They typically remain in courses longer, as well as continuing to re-enroll at CCCCD longer than students taking the same courses and not involved in mentoring activities.

In the future, we will need to be more aware of retaining students for one-two years. The nature of the typical Collin County CCD student implies transience and difficulty in retaining them. Shorter-term measures of retention, such as retention in a course, completion of the core curriculum, completion of math lab certificates, and honors certificates are more immediate goals.

Impact of the IR Office – There are often unspoken questions about the quality of educational programs at community colleges compared to those of universities and skepticism among community colleges about the availability of university faculty to entering students at universities. Insufficient research exists comparing success rates of students after taking specific courses at a community college and continuing to the next level course at a university (e.g., measuring the success of students taking Calculus II at a university who took Calculus I at a community college). The LSAMP started a dialogue between the campus partners and, with the involvement of IR staff at both types of institutions, encouraged institutions to examine more systematically whether it makes a difference where the student takes the first-level course. In some courses it has been found that the students taking the first course at a community college do fine in the next level class at the university. In others, faculty engaged in joint planning to adjust the curriculum to include the essential material so that the community college student is better prepared. This type of analysis and dialogue has to take place on a course-by-course basis, yet some times the numbers of students enrolled at the university in specific second-level courses may be too small to generalize about their performance.

On the assessment front, U.T.-El Paso and other partners demonstrated how the institutional research office can work in partnership with innovative faculty to create a model that is especially relevant for gateway courses and other curricular sequences. Institutions that are concerned about improving freshmen retention rates, increasing the number of students who enter fields with challenging gateway courses, raising graduation rates, and/or demonstrating that their graduates have attained specific knowledge and skills should find the **ICE^2** model to be useful.

Enhanced learning can impact retention by developing students' knowledge base and reinforcing their confidence in their ability to master the concepts of the discipline. Increasing the number of successful students at the undergraduate level should create a larger cohort of students who are more interested in the SMET disciplines and more motivated to continue on to graduate school. Institutional research is needed to explore the impact of such teaching strategies on persistence. By encouraging faculty and institutional research offices to work together, the LSAMP continues to have an opportunity to contribute to further understanding of these efforts.

Data sharing between feeder community colleges and partner universities is occurring, but agreements have to be developed on what data elements are needed, how many and what courses taken at a community college define a student as a "true transfer," and, most importantly, how to use the data for improvement of both campuses. Both institutions should move cautiously so that trust will grow and each institution can better accomplish its goals and share in improvements of curricula, instructional techniques, and institutional procedures. U.T.-System LSAMP experience demonstrated the importance of group dialogues and sharing of experiences, both positive and negative, to generate such trust. The IR office has an integral role in this process.

IMPLICATIONS: WHAT'S NEXT

From the initiation of the Alliance, many faculty and academic leaders recognized that it is quite difficult to impact something as complex and abstract as institutional retention and graduation rates. As the statewide debate over improvement of educational systems intensified, most came to accept that the problem actually spans the educational continuum from early childhood

interventions through graduate school. Nonetheless, the LSAMP demonstrated that a combination of systemic focus and campus creativity can make a notable impact.

Determining why a student or groups of students leave college (and conversely what can be done about it to retain them and improve their academic achievement) has historically challenged educators. As three U.T.-Austin institutional researchers point out, higher education leaders have struggled for decades to understand why students leave college before graduation:

> Early retention research focused on student characteristics such as gender, racial/ethnic background or socioeconomic factors. More recently, researchers, such as Astin, Pace, Tinto, Pascarella and Terenzini, developed interactional theories of student departure from college. According to these theories, leaving college is a function of the student's experience in the total culture of the institution including the formal and informal aspects of this organization. However, the interactional theories of student departure also have limitations. For example, external forces (e.g. work off campus, effects of commuting, volunteer participation in community events) have not been considered. Nor do these theories adequately account for the internal organizational policies and procedures that influence whether students stay or leave (Hossler, 1991). Tinto (1986, 1987) and others (e.g. Hossler, 1991) have called for a more comprehensive theory of student departure, one that includes a more detailed definition of "dropping out", accounts for the rich variety of ways students are involved and interactive with the formal and informal aspects of the institution, incorporates the time-specific nature of the departure process, includes the relative impact of institutional policy and procedures, as well as some measure of the quality and intensity of student effort in the academic experience. (Ruddock, Hanson & Moss, 1999).

For the U.T.-System LSAMP, there are two ways to think about "attaining program goals." One is an absolute measure, "Did the baccalaureate graduation rate of under-represented minority students in the U.T.-System universities increase by 100% over the initial five-year funding period?" The answer to this question, unfortunately, has to be, "No." However, if the question is answered in terms of: Was progress made? Was policy attention brought to the issue? Did the partners learn anything of importance?, then the answer has to be a resounding, "Yes!"

Progress has been made, even though not as much as projected in the original goals. However, the U.T.-System leadership had argued from the beginning with NSF that it was clearly unrealistic to double the number of baccalaureate degrees in five years. As they pointed out, organizing the project and building the university/community college partnership would

probably take one-two years of start-up activity, and, indeed, that proved to be true. What has been important is the maintenance and continuity of momentum, and this continues to be demonstrated in the overall increases in degree production and the long-term success of the LSAMP scholars, both those from the community colleges and those from the universities.

The national LSAMP program targeted talented under-represented minority students at the undergraduate level who had demonstrated interest in science, engineering, mathematics, and technology careers. The U.T.-System LSAMP emphasized early identification of those students through the development of a partnership between its universities and their nearby community colleges. The Alliance institutions aimed to align and improve gateway course curricula and to mentor such promising students, encouraging their persistence at the university campus and the transfer of community college students into universities, and guiding both groups toward completion of the baccalaureate degree and application to SMET graduate programs.

While notable progress has been made in the U.T.-System Alliance's goal to increase the number of baccalaureates earned by under-represented minority students in SMET fields, the focus is now shifting to graduate education. The National Science Foundation (2000) report "Science and Engineering Indicators" documents that enrollment in U.S. graduate school science programs fell each year from 1993 through 1997 (the most recent data available). Among the reasons cited for this decrease are: the drop in the number of foreign-born students, the surging economy, and a lack of faculty openings. In response an National Science Board member, "called for 'a revitalization of math-and-science education' from elementary school through college. 'That will create more interest and excitement for pursuing graduate schools and going for Ph.D.'s.'" (National Science Foundation, 2000).

CONCLUSIONS

This overview of the U.T.-System LSAMP has illustrated three major points: 1) initiation of the program highlighted the need for data and research in the area of under-represented minority participation in SMET majors; 2) the community college/university partnership is innovative and necessary for success; and 3) although sometimes overlooked, the Institutional Research office can play a major role in building and maintaining such a partnership.

Lack of Data on Under-represented Minority Student Achievement in SMET Majors -- The U.T.-System LSAMP was organized and funded at an opportune time. Major Texas employers were growing increasingly vocal about the limited academic skills and workforce preparedness of high school and college graduates. In addition, the Texas Legislature, The University of Texas Board of Regents, and the Commission on Colleges of the Southern Association of Colleges and Schools were each increasingly interested in higher education accountability, student outcomes, and assessment.

The clearly defined goals, baseline data, benchmark measures, and annual presentation of LSAMP progress were a major component of its mission. Not only were the campus level data extensive; when aggregated, the data were easily compared to show performance across campuses. The LSAMP program was the first to actually compare the matriculation of under-represented student groups in science, engineering and mathematics across the U.T.-System campuses and to present the findings not only to university and community college administrators on the LSAMP Governing Board, but also to the U.T.-System Executive Vice Chancellor for Academic Affairs and the university presidents at System meetings.

The Innovative, Essential University/Community College Partnerships -- Higher education analysts have long argued that collaboration among faculty at community colleges and baccalaureate-granting institutions is the central, essential element in successful transfer efforts (National Center for Academic Achievement & Transfer, 1991). The U.T.-System LSAMP attempted to build formal channels for such cooperation and to measure its effectiveness. The challenge of developing partnerships between community colleges and universities can be complicated by competition for enrollment-driven state funding, especially in a time of declining or level enrollments.

Nonetheless, a student who successfully transitions from a community college to a university becomes a long-term asset for both institutions. One LSAMP goal was to measure the successful transfer of community college students to universities. Outcome measures of this sort highlighted the contribution of the community college partners and stimulated increased

institutional effort to maintain dialogue, explore curricular alignment, and share innovative practices.

The Role of the Institutional Research Office in the Partnership – When the national LSAMP project was initially conceptualized, NSF leaders emphasized the specification of targets for increased baccalaureate degrees and for reliable, timely data to report on the project's progress. If thought was given to institutional research offices, the only expectation was for data transmission in the format and by the deadlines that NSF required. In contrast, the U.T.-System LSAMP sought to conceptualize the Alliance as an innovation within its existing formal System of universities that were going to align themselves more closely, reach out to nearby community colleges, and seek to establish a new type of partnership. In addition to that major step, the U.T.-System LSAMP established a statewide Evaluation Coordinator, who proposed the creation of an Evaluation Task Force to work in partnership with the Academic Leadership Council. She argued that the resulting dialogue across offices of Institutional Research and between the academic leaders and the individuals responsible for reporting would generate both more reliable data and more useful information for policymakers, both at NSF and on the participating campuses.

The U.T.-System LSAMP model did indeed provide assurances of accurate reports. For example, the differences in definitions of data elements between the Texas state higher education reporting system and the AMP system of NSF had to be addressed at the beginning to ensure that each institution was reporting the same information. Perhaps more importantly, the Alliance opened up dialogues about research and evaluation matters of significance to all public higher education institutions. Differences between community colleges and universities in terms of reporting requirements, resources available to IR offices, institutional missions, and student characteristics provided plenty of learning opportunities.

Other key issues that were explored jointly by the LSAMP Academic Leadership Council and Evaluation Task Force included:

- Specification of realistic timelines for both institutions and student groups to change historical patterns of retention, persistence, and graduation among under-represented minority students,

- More accurate description and definitions of transfer patterns and concurrent enrollment by students between and among institutions,
- Review of the Federal Educational Right to Privacy Act and its implications for institutional exchanges of data sets for longitudinal tracking of students,
- Discussion of the Texas Legislative Budget Board's higher education accountability system and performance measures and how such information could be supplemented with campus information for use by policy makers to improve student academic progress,
- Exploration of the impact of the Hopwood decision on NSF's Congressional mandate and on U.T.-System LSAMP institutions, and
- Acknowledgment of and respect for administrators' concerns about institutional image and the possibility of data being misinterpreted for sensationalist reasons.

The common goal of increased academic success by under-represented minority students and each campus president's commitment of significant faculty and staff support to the LSAMP effort constituted the glue that held the Alliance together, making it possible to address and resolve differences in institutional practices even when individual representatives changed.

In its report **Closing the Gaps, By 2015**, the Texas Higher Education Coordinating Board (2000) challenged Texas institutions of higher education to raise the college-going participation rate of Texans to that of the leading states and, therefore, to add an additional 500,000 students over the next 15 years. The Coordinating Board identified four fundamental goals: better preparation, enhanced access, increased participation, and elevated excellence. The special study on Texas colleges and universities established by then-Lieutenant Governor and now Governor Rick Perry endorsed the Coordinating Board's plan to increase participation in higher education substantially in this time span, particularly among populations traditionally under-represented in Texas institutions of higher education (Special Commission on 21st Century Colleges and Universities, 2001). And in its long-range plan, The University of Texas System (2000) declared its readiness to play a major role in increasing African-American and Hispanic rates of participation and success in its universities so that these groups achieve parity with current Anglo graduation rates by 2030.

This paper's description of The University of Texas System LSAMP aimed to illustrate the important role assumed by Institutional Research offices in the LSAMP partner institutions' coordinated initiative to increase the retention and academic success of under-represented minority students. What might have looked in 1990 like just another federal fad that would pass as others emerged is now viewed as one of the most critical public policy priorities for the State of Texas. Thus, perhaps as Texas goes, so goes the nation, on this issue as on some others. The U.T.-System LSAMP model that encompassed major responsibilities of data analysis and documentation by Institutional Research offices will, therefore, become even more relevant and useful. Institutional research professionals should prepare themselves to understand this policy arena and to contribute their analytical skills in addressing such an important higher education challenge.

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